REMARKS

The March 14, 2008, Office action rejected claims 1-12. To expedite prosecution of this case, this Amendment and Response amends claims 1-12, without prejudice or disclaimer, and submits the following remarks in support of patentability. Applicant reserves the right to pursue the subject matter of the original claims in co-pending applications. Support for the amendments may be found in the originally filed specification, claims and figures; no new matter has been introduced. In view of the amendments and remarks presented in this paper, reconsideration of the application is respectfully requested.

Claim Rejections under 35 USC 102(b)

In the March 14, 2008, Office action, the Examiner rejected claims 1, 2, 7, and 8 under 35 USC 102(b) as being anticipated by Ohmori (U.S. Patent no. 4,653,448). For the following reasons, reconsideration and withdrawal of these rejections are requested.

Applicant's amended claim 1 requires both: (a) ***applying a first drive current signal to the spill valve***; AND (b) ***applying a second drive current signal to the nozzle control valve***. Inherent in this pair of method steps is the requirement that the controlled fuel injection system include BOTH a spill valve AND a nozzle control valve (i.e., TWO valves).

Ohmori, on the other hand, describes an injector whose timing and injection quantity can be controlled using a ***single solenoid valve*** (see, e.g., column 1, lines 28-42; column 6, lines 49-53). With reference to the description of the operation of the Ohmori system (see column 5 onwards), it is notable that: (i) the injector of Ohmori et al. only has a single electromagnetic valve (valve 52; see also column 6, lines 49-53); and (ii) the Ohmori injector does not have a nozzle control valve.

The Examiner has suggested that component 126 (which Applicants interpret as being intended to reference needle valve 124) of Ohmori et al. is equivalent to the nozzle control valve 22 of Applicant's claimed invention. Yet, Applicant respectfully submits that the needle valve 124 of Ohmori et al. is, in fact, similar to valve needle 12 of the present application, and not to Applicant's nozzle control valve 22. Thus, Applicant respectfully submits that Ohmori fails to anticipate Applicant's nozzle control valve. Moreover, Applicant submits that Ohmori describes (at column 6, lines 5-13) what is, in effect, a "dumb

injector," in which the needle is lifted when the fuel pressure exceeds the nozzle opening pressure. Thus, the check valve 82 is also not equivalent to nozzle control valve 22 of the invention either. Finally, Applicant submits that, in Ohmori, the spill event from the injector chamber is triggered by the spill plunger uncovering a port (see, e.g., column 6, lines 22-31).

Thus, present independent claim 1, as amended, defines an invention that is not anticipated by Ohmori or any other prior art reference. In other words, for at least for the reasons cited above, claim 1, as amended, is allowable. Still further, claims 2 and 7-8 variously depend from amended claim 1. Therefore, since claim 1 is allowable for the reasons set forth above, dependent claims 2 and 7-8 are also allowable. Reconsideration and withdrawal of the rejections of claims 1-2 and 7-8 are requested.

Claim Rejections under 35 USC 103(a)

In the March 14, 2008, Office action, the Examiner variously rejected claims 3-6 and 9-12 under 35 USC 103(a) as being unpatentable over various combinations of Ohmori and Archer (U.S. Patent no. 4,653,448) and Straub (U.S. Patent no. 7,150,410). For the following reasons, reconsideration and withdrawal of these rejections are requested.

As discussed above, Applicants have amended independent claim 1 and respectfully submit that, as amended, claim 1 is allowable over the prior art of record. More specifically, Applicant's amended claim 1 requires both: (a) ***applying a first drive current signal to the spill valve***; AND (b) ***applying a second drive current signal to the nozzle control valve***. Inherent in this pair of method steps is the requirement that the controlled fuel injection system include BOTH a spill valve AND a nozzle control valve (i.e., TWO valves). Neither Ohmori nor Archer nor Straub nor any other prior art reference, alone or in combination, discloses Applicant's control method. Thus, present independent claim 1, as amended, defines an invention that is not obviated by Ohmori, Archer, Straub, or any other prior art reference, alone or in combination.

In the March 14, 2008, Office action, the Examiner asserted that it would have been obvious to the skilled person to modify the opening and closing times of the spill and nozzle control valves of Ohmori et al. with a time of between 0.05 and 2 ms.

Applicant respectfully submits, however, that, unlike the prior art, the presently claimed invention provides two controllable valves (i.e. spill valve 20 and nozzle control valve 22), that are opened and closed with specific relative timing. This control method provides the

advantage that mechanical noise in the injector is reduced, for example, as described at page 4, lines 6-12 of the application as filed, which states:

"One advantage of the present invention is that the valve needle is caused to close whilst the spill valve is moving from its closed state to its open state. The rate of flow of fuel through the spill valve to low pressure (i.e. the "spill rate"), and thus the rate of decrease in injection pressure at the end of injection is therefore reduced due to the reflected or positive pressure wave generated by closure of the valve needle. Thus, mechanical noise generated as a result of drive load overshoot, and separation and re-contact of the associated pump drive components, can be reduced or avoided".

Further in this respect, Figure 4 of the application demonstrates that the nozzle control valve is closed (see trace "e") during the opening period of the spill valve (trace "b").

Contrariwise, Ohmori describes an injector in which injection timing and injection amount can be controlled using a ***single solenoid valve*** (see column 1, lines 28-42; column 6, lines 49-53). This document does not disclose or suggest an electromagnetic valve that is equivalent to nozzle control valve 22 of the present invention. In fact, it is not surprising that Ohmori would fail to anticipate Applicant's method since Ohmori makes no mention whatsoever of the problem of mechanical noise in the fuel pump. Hence, on reading Ohmori et al., the skilled person would not have been prompted to modify its apparatus to include a second electromagnetic valve, and certainly not an electromagnetic nozzle control valve, such as valve 22 of the invention.

Furthermore, there is no consideration whatsoever in Ohmori et al. of the relative timings of opening and closing of any of the "valves" described therein. For example, the "spill" paths (see 116 and 98) from the injection plunger 74 are operational only once the injection plunger 74 has moved through a predetermined distance, such that the fuel spill paths are opened. Thus, the opening of the spill paths is entirely unrelated to the opening and/or closing of the electromagnetic valve 52. There is also no mechanism in Ohmori et al. which would allow the opening or closing of the spill paths 98 and 116 to be timed relative to the opening / closing of the electromagnetic valve 52. Referring to check valve 82 in Ohmori et al. , as already noted, this is no more than a "dumb injector", which opens when the fuel pressure exceeds its nozzle opening pressure (against the action of a valve spring 88). Again, therefore, this valve is not controlled relative to the opening of the electromagnetic valve 52. Finally in this regard, contrary to the Examiner's suggestion, the valve needle 124 of Ohmori

et al. cannot be equated to the nozzle control valve 22 of the invention and, even if it were, there is no suggestion of how its closing may be timed relative to the opening of the electromagnetic valve 52.

Therefore, even if Ohmori et al. did disclose a nozzle control valve, such as valve 22, which is denied, there is no teaching or suggestion in Ohmori et al. that would have lead the skilled person to adjust the relative timings of any such spill and nozzle control valves.

For the sake of completeness, Applicant finally refers to the Examiner's suggestion that Figure 2 of Ohmori et al., and in particular Figures 2D and 2F, indicates that the operation of the injection system of Ohmori et al. falls within the scope of the claimed invention. Applicant respectfully points out, however, that the Examiner may have misinterpreted the "spill valve opening period" of Claim 1 to mean the period in which the spill valve is open, rather than as the period during which the spill valve moves from a closed state to an open state. In Figures 2D and 2F of Ohmori et al. there is absolutely no suggestion that a "nozzle control valve" (such as valve 22 in the invention) is closing during an opening period of the spill valve. First and foremost, Figure 2F does not relate to the status of a nozzle control valve in accordance with the invention, but rather with the fuel injection event per se. Furthermore, Figure 2D does not indicate that there is a "period" during which the spill valve is opening – instead there is a rapid (immediate) transition from the open to closed states (see square wave of Figure 2D).

Simply put, the teaching of Ohmori et al. does not even consider the relative timing of the opening and/or closing of a spill valve and a nozzle control valve and, therefore, it cannot render the subject-matter of claims 3-6 and 9-12 obvious.

Thus, the present claims 3-6 and 9-12, as amended, define an invention that is not anticipated, and therefore cannot be obviated, by Ohmori, Archer, Straub or any other prior art reference, alone or in combination. In other words, for at least for the reasons cited above, claims 3-6 and 9-12, as amended, are allowable. Reconsideration and withdrawal of the rejection of claims 3-6 and 9-12 are requested.